

TABLE 2.—Free-air resultant winds (m. p. s.) during June, 1924

Altitude, m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Dus West, S. C. (217 meters)				Ellendale, N. Dak. (444 meters)				Groesbeck, Tex (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		6-year mean		Mean		9-year mean		Mean		4-year mean		Mean		7-year mean		Mean		6-year mean		Mean		6-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface.....	S. 5°W.	4.7	S. 4°W.	4.0	S. 47°E.	1.5	S. 1°E.	1.6	N. 75°W.	1.6	S. 86°W.	1.0	N. 2°W.	1.1	S. 34°E.	0.2	S. 21°W.	5.0	S. 7°E.	3.2	S. 63°W.	1.1	S. 54°W.	1.2
250.....	S. 5°W.	4.8	S. 4°W.	4.1	S. 47°E.	1.8	S. 1°E.	2.2	N. 78°W.	1.7	S. 84°W.	1.1	N. 2°W.	1.1	S. 34°E.	0.2	S. 20°W.	6.0	S. 6°E.	3.8	S. 60°W.	1.3	S. 53°W.	1.3
500.....	S. 5°W.	6.2	S. 9°W.	5.4	S. 56°E.	1.8	S. 1°E.	2.2	N. 89°W.	2.7	S. 81°W.	1.6	N. 9°E.	0.8	S. 16°E.	0.4	S. 22°W.	7.9	S. 1°W.	5.3	S. 55°W.	1.8	S. 47°W.	2.2
750.....	S. 13°W.	7.1	S. 14°W.	6.1	S. 58°E.	2.5	S. 10°W.	3.2	S. 85°W.	3.4	S. 75°W.	2.4	N. 16°W.	0.4	S. 4°W.	1.1	S. 22°W.	8.6	S. 4°W.	5.7	S. 64°W.	3.6	S. 65°W.	2.9
1,000.....	S. 23°W.	7.2	S. 21°W.	6.3	S. 61°E.	2.5	S. 25°W.	3.6	S. 87°W.	3.3	S. 77°W.	2.3	N. 74°W.	0.8	S. 19°W.	1.5	S. 26°W.	9.1	S. 9°W.	6.2	S. 86°W.	5.3	S. 70°W.	3.6
1,250.....	S. 36°W.	7.5	S. 26°W.	6.3	S. 23°E.	2.0	S. 37°W.	4.0	N. 85°W.	5.1	S. 81°W.	2.9	S. 84°W.	1.0	S. 42°W.	2.0	S. 27°W.	8.4	S. 10°W.	6.4	N. 86°W.	5.7	S. 78°W.	4.0
1,500.....	S. 44°W.	8.1	S. 31°W.	6.4	S. 10°W.	1.9	S. 50°W.	4.4	N. 88°W.	6.3	S. 84°W.	3.8	S. 89°W.	1.6	S. 47°W.	2.5	S. 28°W.	7.7	S. 12°W.	5.9	N. 87°W.	7.6	S. 85°W.	4.5
2,000.....	S. 53°W.	7.6	S. 38°W.	6.6	S. 67°W.	3.4	S. 56°W.	5.7	N. 80°W.	10.7	S. 89°W.	6.0	S. 85°W.	3.2	S. 59°W.	3.5	S. 26°W.	6.8	S. 13°W.	5.4	S. 84°W.	9.5	S. 84°W.	6.7
2,500.....	S. 59°W.	8.9	S. 39°W.	6.7	N. 76°W.	10.5	S. 71°W.	7.2	N. 85°W.	11.7	S. 89°W.	6.3	N. 81°W.	6.2	S. 72°W.	5.3	S. 23°W.	6.2	S. 16°W.	5.4	S. 81°W.	10.9	S. 82°W.	8.5
3,000.....	S. 74°W.	7.7	S. 40°W.	6.4	N. 63°W.	14.6	S. 77°W.	8.6	N. 80°W.	12.0	W.	7.9	N. 86°W.	7.9	S. 80°W.	7.3	S. 29°W.	6.3	S. 18°W.	5.6	S. 63°W.	12.2	S. 85°W.	10.2
3,500.....	S. 82°W.	7.0	S. 45°W.	7.2	N. 64°W.	15.9	S. 79°W.	9.3	N. 72°W.	11.9	S. 82°W.	8.4	S. 79°W.	12.4	S. 80°W.	9.1	S. 34°W.	3.3	S. 11°W.	5.7	-----	-----	-----	-----
4,000.....	N. 77°W.	10.6	S. 54°W.	7.4	N. 77°W.	15.5	N. 85°W.	8.8	N. 68°W.	10.2	S. 82°W.	9.5	S. 76°W.	15.2	W.	11.3	S. 64°W.	5.8	S. 11°W.	6.4	-----	-----	-----	-----
4,500.....	N. 70°W.	13.6	S. 84°W.	8.0	N. 45°W.	16.5	N. 75°W.	8.6	N. 59°W.	14.7	N. 65°W.	13.2	N. 66°W.	16.3	N. 76°W.	12.9	S. 68°W.	9.5	S. 6°E.	8.3	-----	-----	-----	-----
5,000.....	N. 56°W.	12.5	N. 68°W.	12.4	N. 45°W.	16.6	N. 51°W.	18.5	-----	-----	-----	-----	-----	-----	-----	-----	S. 68°W.	9.9	S. 68°W.	9.9	-----	-----	-----	-----

## THE WEATHER ELEMENTS

By P. C. DAY, Meteorologist, in Charge of Division

## PRESSURE AND WINDS

As was the case during the preceding month, there were frequent cyclonic developments over the interior portions of the country, particularly from the Rocky Mountains to the Ohio Valley, giving much cloudy, rainy weather over the central valleys, although few of these disturbances reached important proportions or maintained their identity for considerable periods of time. Although, as often happens in summer, these cyclonic conditions were not pronounced, they gave rise to frequent local disturbances such as thunderstorms, hail and wind storms and even tornadoes of severe character, and the month as a whole had an unusual number of such storms.

The first cyclone of the month to develop into importance was central on the morning of the 5th over the middle Missouri Valley, extending northward to Manitoba. This moved rapidly northeastward beyond Lake Superior during the following 24 hours, but it was attended by heavy rains in portions of the Mississippi Valley and by severe local storms in Illinois and near-by States.

Immediately following this, cyclonic conditions developed over the Plateau region, and by the morning of the 7th a disturbance of considerable importance was central over the middle Rocky Mountains. As this moved slowly eastward into the central valleys, heavy rains occurred over wide areas, and severe local storms were reported from many sections of the Mississippi Valley and to the eastward. Low pressure, with attendant showers and local heavy storms persisted over much of the Mississippi and Ohio Valleys and to the eastward until about the middle of the month. On the morning of the 17th unsettled weather had again overspread the western mountains and Great Plains, and heavy rains with local severe storms prevailed during the following 24 to 48 hours from the Mississippi Valley northward to the Dakotas and into the adjacent portions of Canada, the storm having been forced far to the northward on account of anticyclonic conditions existing over the upper Lakes.

Unusually heavy and widespread rains occurred during the first half of the last decade over many sections from the Great Plains eastward, although there were no important cyclonic developments until toward the end of the period.

Toward the latter part of the month pressure diminished over the central valleys, and by the morning of the 28th a fairly well-defined low-pressure area was central over the upper Mississippi Valley. During the following 24 hours this depression moved over the Great Lakes region into the St. Lawrence Valley, attended over portions of northern Ohio during the afternoon of the 28th by one of the severest tornadoes of recent years, a full account of which will be found elsewhere in this issue.

Anticyclones were mainly weak and confined principally to the more northern localities. Those materially affecting the weather occurred during the early part of the second decade, when a high of the Hudson Bay type overspread the more eastern States, giving cool northeasterly winds to those regions; and again near the end of the month an anticyclone moved from western Canada into the Missouri Valley, giving moderately cool weather at the end over most districts.

The distribution of the atmospheric pressure during the month had no pronounced tendency, further than toward lower than normal averages over the central and eastern districts, and to somewhat higher than normal averages over the northwestern and far western districts. Average pressures were higher than during the preceding month from the Mississippi Valley eastward, and mainly lower to the westward.

Despite the fact that barometric changes were mainly slight and the gradients usually shallow, local high winds were frequent and often associated with hail, causing wide damage to crops and injury to trees, buildings, etc. A list of the more important storms of the month follows at the end of this section.

## TEMPERATURE

At the beginning of the month temperatures remained below normal from the Great Plains eastward, as had been the case during the preceding month, while west of the Rocky Mountains warm weather continued, though there was some relief from the severe heat experienced during much of the preceding month.

The seven-day period, the 3d to 10th, continued cold over most central and all northern districts, the temperature averages for the week ranging mainly from 6° to 12° below the normal. In the more southern States, however, a change to conditions more nearly normal with regard to temperature had set in and the week as a whole was moderately warmer than normal.

The week following the 10th brought a marked rise in temperature over most northwestern districts during the

early portion, but it still continued unseasonably cold in the northeastern States. The week as a whole was moderately warm in all portions save from the Great Lakes northeastward to New England and southeastward to the Carolinas, where temperatures still continued below the seasonal normal, and over interior California where moderate temperatures were a welcome relief from the excessive heat that had persisted for a number of weeks.

The week ended June 24 was the first over a long period with average temperature above the normal over all eastern districts, and it was decidedly warm during the early part over the Southwest, where high temperatures had persisted for a considerable period. From the Dakotas westward to the Pacific and generally over the Plateau region this week was moderately cool.

The last week of the month continued warm over most southern and all far western districts, the temperatures continuing high over the southern Plains. The week was moderately cool, however, over nearly all central and northern districts, and distinctly cool over the central districts at the close.

The warm periods of the month were mainly during the latter half, generally near the end of the second decade over the districts from the middle and southern Rocky Mountains eastward, and near the close of the month from the Dakotas westward and southwestward to the Pacific coast.

Over portions of New Mexico and adjacent States excessive heat was almost continuous from the beginning of the second decade until near the close of the month, probably the longest period of intense heat ever known in that district. At points in Nevada, Idaho, and Washington the maximum temperatures on the 30th were the highest of record for June.

The lowest temperatures of the month were mainly during the first week from the Great Plains eastward and near the middle of the month in some of the Plateau and Pacific Coast States. Freezing temperatures were reported at some period during the month from exposed points in all the northern tier of States and generally at the high elevations of all the Western Mountain States. A minimum temperature of 26° was reported from Pennsylvania, 24° from Wisconsin, 28° from South Dakota, and as low as 14° in Colorado.

For the month as a whole the average temperature was mainly below normal from the central and northern Rocky Mountains eastward to the Atlantic coast, the greatest departures, ranging from 3° to 4°, occurring from central Montana and northern Wyoming eastward to the Great Lakes, northern New York, and the interior of New England. The month was mainly warmer than normal over southern and western districts, the excesses being large from the Southern Plains westward to Arizona and eastern California. At a few points the month was unusually warm, notably at Tampa, Fla., and Roswell, N. Mex., where it was the warmest June of record.

#### PRECIPITATION

Over the great central and southern districts there were many sharp variations in the amounts of precipitation received during the month. In portions of the Missouri

and middle Mississippi Valleys and adjacent areas precipitation was frequent and the total falls far above normal. On the other hand, near-by areas in Kansas, the southern drainage area of the Ohio, and localities in the Great Lakes region had far less than the normal fall. Similar conditions existed in the Southern States, where in the coast districts of Texas the falls were in some cases the greatest of record for June, while other portions of the State, as well as near-by areas of adjacent States, suffered greatly from drought.

In the far West drought continued, and the general lack of moisture for the season to date, associated with high temperatures that have prevailed for many weeks, has produced a serious water shortage in many sections. The early melting of the slight snow cover in the mountains of California and the adjacent portions of Nevada and Oregon has reduced the flow of the rivers and streams to the lowest stages ever known. The long drought has greatly depleted the reserve of underground water and it is becoming increasingly difficult to secure necessary supplies even from that source.

On account of the prolonged drought, forest fires increased in these and other western districts and have been controlled only with great difficulty. In Arizona, New Mexico, and other portions of the Southwest, where the rainy season usually begins in June, rains were delayed very generally until near the end of the month, and these were usually light, except in portions of Arizona, where moderate falls occurred locally. In Colorado the month was the driest of record for June.

Some good rains occurred in the Dakotas and most other portions of the eastern spring-wheat region, but it continued dry in the far Northwest, where precipitation has been deficient for many months.

#### SNOWFALL

Unusually heavy snow, for so late in the season, occurred over northwestern Montana on the 7th, falling to depths up to 14 inches and causing much damage to trees. At Kalispell a depth of 9 inches was measured, being the greatest depth of snow ever recorded at that station in any month of the year save one.

Due to the continued high temperatures, snow in the mountains of California decreased rapidly and disappeared entirely from peaks that had not been free from snow so early in the season within the memory of the oldest inhabitants.

#### RELATIVE HUMIDITY

The frequent and locally excessive precipitation and generally cloudy weather over much of the Missouri, upper Mississippi, and Ohio Valleys, and eastern districts indicate an unusually moist condition of the atmosphere and this is shown by the monthly percentages of relative humidity which were in many sections of these areas far above normal. On the other hand, the percentages over nearly all far western districts, where drought has existed for long periods were nearly everywhere greatly deficient.